Bone Banks

A New Concept in Procurement and Storage for Homologous Grafts

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• **An unlimited supply of bones, obtained postmortem and irradiated to make them sterile, is stored for as long as six months in a freezer, ready for use. After an immune response at first, bone thus treated is readily incorporated by the host in grafting procedures.**

A SUPPLY of an unlimited amount of bone for grafting has always been a great problem to surgeons. In children this has been an even greater problem as there is no ready source. In the past, bone banks were composed of sterile specimens obtained in the course of various surgical procedures. For example a rib may be obtained from a patient undergoing thoracotomy. This is a very limited source of homologous bone for replacement.

By a new method of procurement the division of orthopedics in the Department of Surgery at UCLA Medical Center has obtained large amounts of sterile homogenous bone for transplantation to patients who require bone grafts of all types and shapes. This is the first bone bank of this type to be established on the West Coast, although the method employed has been utilized for several years in medical centers in the eastern section of the country.

The method that is used to sterilize the bone was worked out by Turner and co-workers[3] and depends upon the use of a Van de Graaff 3 million electron volt machine.

The bone is collected postmortem from suitable bodies under clean but not sterile conditions. The grafts are immediately packaged in plastic bags which are heat-sealed, then placed within two outer bags for additional protection. They are stored in a freezer chest until they are irradiated. After irradiation the grafts are stored up to six months in a freezer, ready for use.

Irradiation with less than 3 million electron volts is not considered adequate for sterilization of the grafts. Cobalt 60 radiation may be used but cannot compete with cathode radiation because of practical considerations.

Most surgeons prefer obtaining bone from the patient at operation, since they feel this is the best bone available for grafting purposes. As previously stated, however, bone cannot be obtained in this manner from children; also in many cases additional bone may be desirable but not used simply because prolonging the operating time might endanger the life of the patient. With a sterile bone bank available, that problem is solved.

In the past, homologous grafting has been rejected by surgeons because the results were not very good. Such grafts were prepared by various techniques such as boiling, removing the organic portion of the bone by various chemicals or rendering the bone sterile by soaking it in antiseptic solutions such as Merthiolate.® It was shown conclusively by Holmstrand[2] that the crystal size in bone that has been heated by any of these methods is larger than in normal bone and is absorbed at a much slower rate by the host. A recent observation that has not been stressed is that autogenous cortical transplants and homogenous cortical transplants are unequivocally incorporated at approximately the same rate by the host.

In a manner similar to other tissue homografts, fresh bone homografts produce an immune response by the host. The degree of this response is determined by the genetic incompatibility between the donor and the host.

In our bone homograft, no cells survive; however, fixed bony contact between the host and the graft is maintained and the nonviable matrix of the graft is invaded by osteogenic cellular elements from the host. Osteogenesis continues until the graft has been replaced entirely by the host. These grafts succeed by offering internal, mechanical, replaceable fixation and a scaffold to guide the osteogenic elements of the host.

Even in autogenous grafts, few cells survive. It has been shown that diffusion is limited to 0.2 mm. in bone matrix under the best conditions, so that most cells die unless they are close to the surface or the graft is revascularized very shortly after transplantation.[1]

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Therefore, the viability of the transplanted osteocytes is not a major factor in either the autogenous or homologous graft. Early progress of the homologous graft may be delayed by the immune response, but the ultimate outcome is the same unless the graft has been altered in some manner by procurement or storage. Bone secured under the method described for our bank most closely resembles unaltered bone.

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REFERENCES

1. Bassett, C. A. L.: Bibliography of bone transplantation, Transplantation Bull., Addendum III, 4:162, 1957.

2. Holmstrand, K.: Biophysical investigations of bone transplants and bone implants; an experimental study, Acta Orthop. Scandinav., Supl. 26, pp. 1-92, 1957.

3. Turner, J. C., Bassett, C. A. L., Pate, J. W., Sawyer, P. N., Trum, J. G., and Wright, K.: Sterilization of preserved bone grafts by high-voltage cathode irradiation, J. Bone & Joint Surg., 38A:862, 1956.